Topographic Maps

One of the most frequently used types of maps in earth science is the topographic map, which depicts the features of an area through the use of contour lines.

Qualities of Topographic Maps

A **topographic map** shows the **topography** (tuh-PAHG-ruh-fee) of an area, that is, its natural and human-made surface features. It indicates landforms such as cliffs, mountains, and beaches; bodies of water; and streets and buildings. To show landforms, maps must show the relief (the highs and lows) of Earth's surface. Relief can be shown in many ways, such as by shading or coloring. Topographic maps are unique and especially useful because they use contour lines to show the relief.

The United States Geological Survey (USGS) has mapped the entire United States in more than 53,000 maps. The USGS updates map information regularly, using information from aerial photography and field checks by volunteer members of the Earth Science Corps. Because making topographic maps is so expensive, most revisions do not involve radical changes. Instead, they involve updating boundary changes or adding features (such as new areas of city growth) that have appeared since the last revision.

A common USGS topographic map is the 7.5-minute map. It shows an area called a quadrangle that spans 7.5 minutes of latitude and 7.5 minutes of longitude. It has a scale of 1:24,000. Because one inch represents 2000 feet, these 7.5-minute maps give detailed information about the areas they depict. Some maps even indicate individual houses.

Topographic maps of Alaska are different from those for the continental United States. Called 15-minute maps, they cover areas of 15 minutes of latitude and 20 to 36 minutes of longitude. USGS 15-minute maps have a scale of 1:63,360 (one inch on this map equals one mile).

3.3

Key Idea

Topographic maps show the natural features of an area and the features created by humans.

Key Vocabulary

- **topographic map**
- **topography**
- **contour lines**
- **contour interval**
- **slope**
- **magnetic declination**

HIKERS, such as this woman exploring New York's Adirondack Mountains, are among the people who find topographic maps invaluable.

A TOPOGRAPHIC MAP The graphic above is a section of the topographic map of the Portland, Maine, area. The city is shown in pink. You will use the line marked "A–B" in the minilab on page 56.

Contour Lines

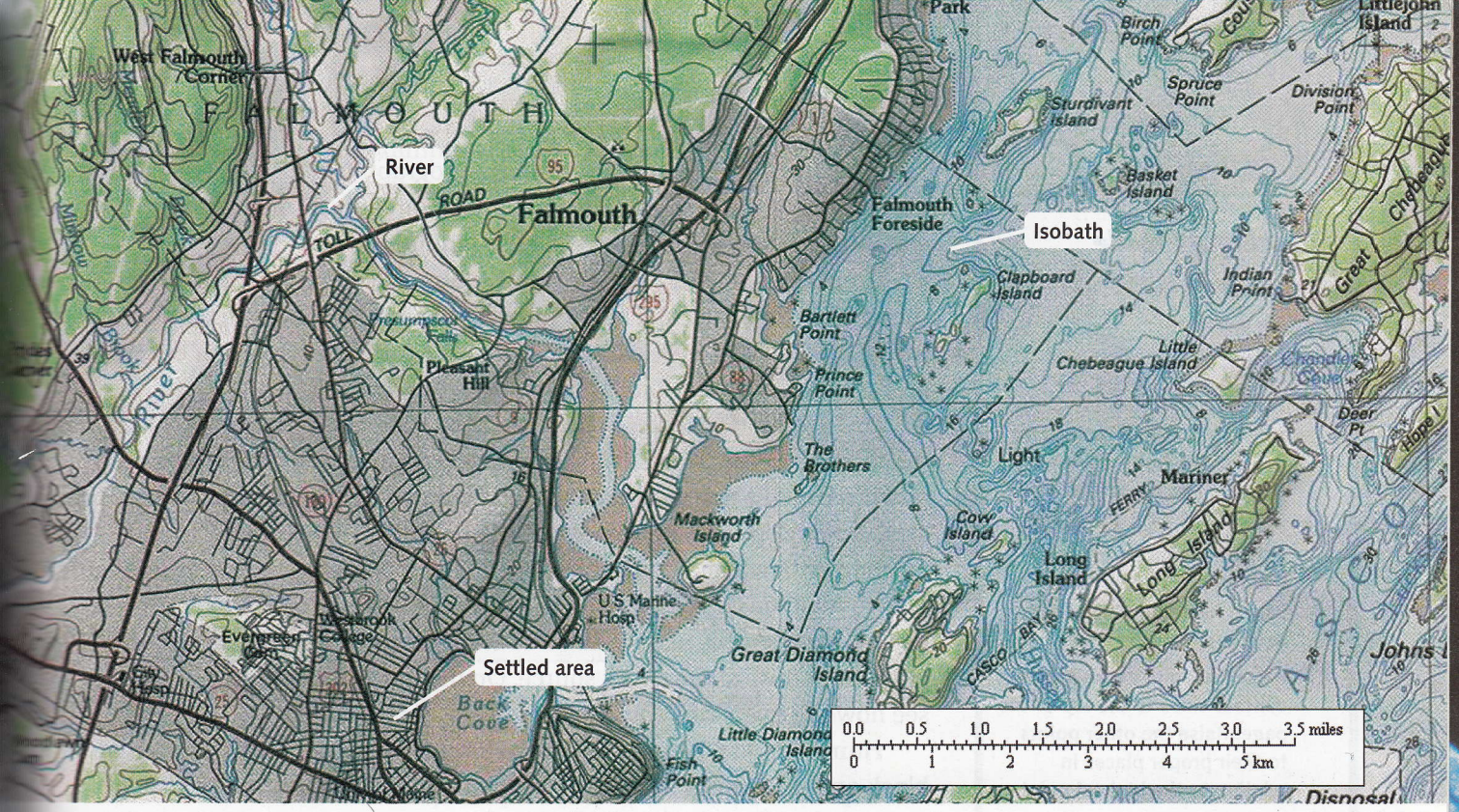
Unlike road maps, topographic maps show the shape of Earth's surface. By reading a topographic map, you can get a mental picture of the shape of the area it depicts if you know how to interpret the contour lines.

Contour lines are the narrow brown lines on topographic maps that indicate the landscape's elevation, or height above sea level. Contour lines are drawn to connect points of the same elevation in an area. They are the key to understanding what you are looking at on a topographic map.

On a contour map of the Maine seacoast, for example, the first contour line is found at zero feet above sea level (at sea level). The next contour line appears 10 feet outside the first one. That means that all the features that this line intersects are 10 feet above sea level. Anything inside the line is between zero and 10 feet above sea level, and anything outside it is more than 10 feet above sea level. The difference in elevation between two consecutive contour lines is called the **contour interval.**

The line above the 10-foot line indicates features at 20 feet; the next line above that indicates 30 feet, and so on, in 10-foot increments. Most of the lines on a topographic map are not marked, but every fourth or fifth interval will be a heavy line, similar to the one you see at sea level, with a number on it (100, 200, etc.) that serves as a reference point (these are called index contours). Not all maps begin at sea level, of course, and some have intervals greater than 20 feet. However, by looking for prominent index contours, you will be able to judge the elevation of the area the map depicts.

Some maps include information on the depths of the water they show; they are called topographic-bathymetric maps. Like the contour lines that show elevations on the land, blue lines called isobaths show the form of the land beneath the water's surface.



Slope and Elevation

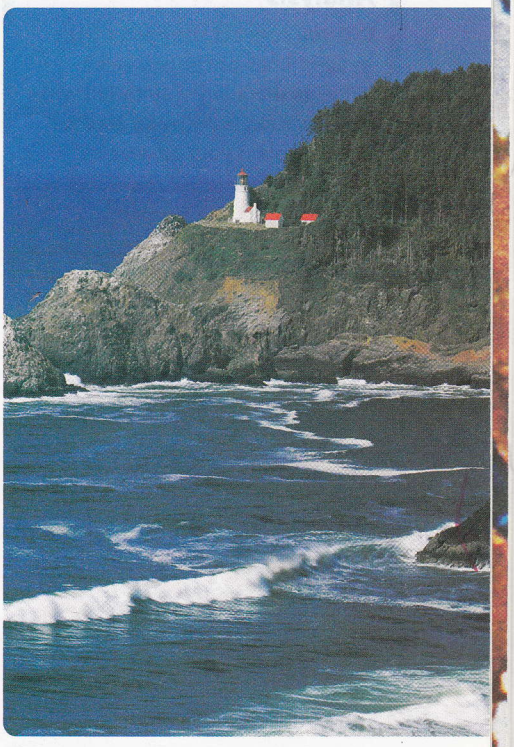
The distance between one contour line and the next shows you the **slope,** or steepness, of the landscape. If the contour lines are very far apart, the landscape is relatively flat. If they are close together, it is steep. To determine the slope of an area, divide the change in elevation by the distance covered. The figure that results will be the average slope.

For example, say you want to find the slope of a mountainside. The point you start measuring is at 1400 feet; the summit is at 3165 feet. The distance you're measuring is two and a half miles.

Subtract 1400 from 3165 to get 1765 feet (the change in elevation). Divide 1765 feet by 2.5 miles, and you get an average slope of 706 feet per mile. The actual slope may be different if some parts of the mountainside are steeper than others.

In mapmaking, surveyors find the exact elevation of many points in the map area. These may be shown on the map in a number of ways. A bench mark is a location whose exact elevation is known. At the survey location, it is noted on a brass or aluminum plate, which is permanently set into the ground. On a map, a bench mark is shown by the abbreviation BM that appears next to a cross, an X, or a triangle. Numbers next to the abbreviation and symbol give the elevation to the nearest foot.

Spot elevations are the elevations of road forks, hilltops, lake surfaces, and other points of special interest. These points are usually shown on the map by small crosses. Numbers giving elevations checked by surveyors are printed in black. Unchecked elevations are printed in brown. Water depths are shown in blue, with blue lines called isobaths indicating the shape of the land below the water.



COAST OF MAINE The topography of Maine can be complex, as this photograph taken near Portland shows.

25-Minute
Mini LAB

Drawing a Profile

Materials

- graph paper

Procedure

1. The map on pages 54–55 has a line from A to B marked on it. Place the bottom edge of the graph paper on that line.
2. At each point where the line crosses a contour, make a mark on the edge of the paper. Record the height of each contour next to its mark.
3. Raise the point at the highest contour close to the top of the page. Raise the other points to their proper places in relation to the highest point.
4. Connect the points to complete your profile.

Analysis

Did you connect the points with straight lines or curved lines? Why? Is there any way to tell what the elevation is between contour lines? Explain your answer.

Understanding Topographic Map Symbols

By understanding the unique symbols topographic maps use, you can tell human-made features, such as buildings, from natural ones. You can tell water from land, and you can visualize landforms.

Contour lines may form circles or ovals. These indicate hills, ridges, or mountains. The peak of a hill or mountain may also include a number, which indicates its elevation. The distance between the contour lines will give you an understanding of the slope of the land.

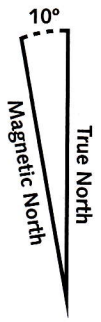
You may find a circle or oval with small lines jutting inward from the main contour line. This symbol indicates a depression in the landscape, and it is called a depression contour. The crater of a dead volcano would be shown by a depression contour.

Bodies of water are indicated in blue on topographic maps. If you know how to read the contour lines, you can figure out which way rivers flow by using a topographic map. When a contour line crosses a river, it forms a point back toward the river's source. On the map on pages 54–55, you can see how the rivers run down toward the sea.

Human-made features, as well as natural landforms, are depicted in black on topographic maps. Roadways, railway lines, bridges, gas and water tanks, dams, and individual buildings are often indicated. Thickly settled regions are depicted in pink.

Maps on which areas have been revised indicate these updated areas in purple. Refer to page 697 for more information about symbols.

Topographic maps have a special kind of compass rose that shows the magnetic declination of the area pictured. Compasses will point to magnetic north, not to true north. The **magnetic declination** is the angle by which a compass needle will vary from true north. Each topographic map gives the angle of magnetic declination for the area it represents.



Approximate Mean Declination, 2001

MAGNETIC DECLINATION This symbol shows the angle by which a compass point varies from true north.

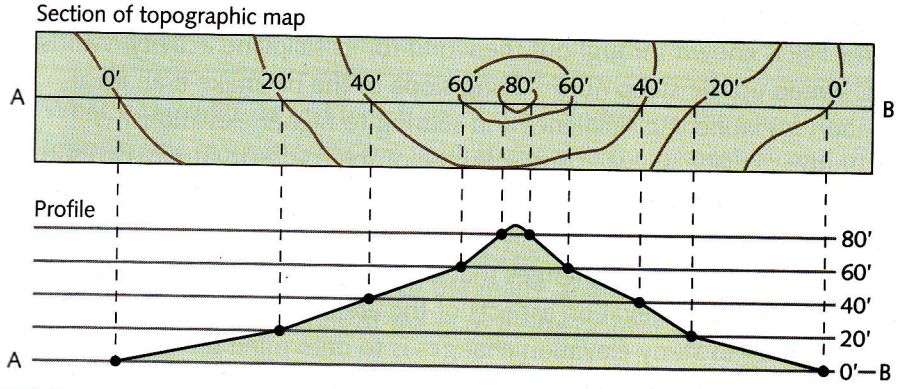
Using Topographic Maps

Topographic maps can be used to determine the shape of the land, the direction of the flow of rivers (as mentioned above), and distance.

It is easy to determine the shape of the landforms depicted on a topographic map. To do this, you draw a line across the map. Wherever the line meets a contour, the exact height above sea level is known. Plotting these points on a vertical scale results in a profile of the land.

A profile is most easily made by placing the bottom edge of a sheet of paper on top of the line to be followed. At each point where the line crosses a contour, make a mark on the edge of the paper. Record the height of the contour next to its mark on the paper. When all points are marked, use the vertical scale to raise each point to its proper height. (Plotting is easier when graph paper is used.) A vertical scale is usually stretched out

compared to the horizontal scale. This is to make the differences in elevation more visible. An example of a vertical scale is $\frac{1}{8}$ inch = 20 feet. Of course, it is important to keep the points the same horizontal distance apart as they were on the map. Once the elevated points have been plotted, they are joined to make the profile.



PROFILE DIAGRAM By transferring information from a topographic map to another sheet of paper, it is possible to the draw a landform's profile, or shape.

To measure distance on a topographic map, you will use the map scale. If the scale of a map is given in words, distances on the map may be measured with a ruler. When a graphic scale is printed on the map, the distance between two points can be marked off with a straightedge, such as the edge of a sheet of paper. A piece of string may also be used. The marked straightedge is held against the scale for reading. Zigzag distances along roads or rivers may be marked off one after the other on the edge of a sheet of paper before measuring against the graphic scale.

Topographic maps are useful in a variety of ways. City planners use them to plan public works projects. Engineers use them when they plan civil engineering projects, such as roads. Researchers use them as they search for deposits of coal, oil, and natural gas. And everyday people use them too, as they hike, camp, orienteer, and otherwise enjoy the outdoors.

3.3 Section Review

1. What do contour lines indicate on a topographic map?
2. What would the topography of an area be like if the contour lines were close together? If they were far apart?
3. Describe how to measure distance using a topographic map.
4. What human-made features might appear on a topographic map?
5. **CRITICAL THINKING** Why do you think USGS cartographers made 15-minute maps for Alaska, instead of 7.5-minute maps?
6. **MATHEMATICS** Determine the slope of an area, given the following: Start measuring at 700 feet. Measure a distance of four miles, and end at an elevation of 2432 feet.
7. **PAIRED ACTIVITY** Working with a partner, select part of the topographic map of the Portland, Maine, area, and create a profile.